
ModemModule GSM/GPRS

Embedded Data/Fax/Voice Wireless Modem

MTMMC-G-F1
MTMMC-G-F2

Developer's Guide



ModemModule GSM/GPRS Developer's Guide
MTMMC-G-F1 and MTMMC-G-F2
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Patents

This device is covered by patent number 5,673,268.

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Chapter 1 – Product Description and Specifications

Introduction

ModemModule GSM/GPRS integrated wireless modems provide a quick and easy way to insert GSM and GPRS functionality into systems and terminals. Available in dual-band configurations, this modem constitutes a self-contained, fully integrated implementation of the GSM/GPRS standard. Thanks to standard interfaces, it can be integrated into any system. It is ready for voice, SMS, data and fax. ModemModule GSM/GPRS is a product with a single connector, which puts together all interface signals in order to facilitate its integration. It has an integrated SIM connector as well as a standard RF connector type MMCX. For system integrators, ModemModule GSM/GPRS is the fast track to the wireless world.



Figure 1-1: MultiTech's Wireless ModemModule GSM/GPRS

Product	Description	Region
MTMMC-G-F1	GSM/GPRS Class 10, 900/1800 MHz	Global
MTMMC-G-F2	GSM/GPRS Class 10, 850/1900 MHz	Global

The MTMMC-G-F1 and MTMMC-G-F2 ModemModules are used to integrate wireless data and fax communications in numerous embedded applications.

Scope of the Developer Guide

This document describes the hardware interface and the technical specifications of the ModemModule GSM/GPRS wireless modems. The integrated modem is referred to as ModemModule GSM/GPRS according to the GSM/GPRS 900 standard, the GSM/GPRS 1800 standard and the GSM/GPRS 1900 standard. This product is based on a Dual Band RF module: every integrated modem referenced ModemModule GSM/GPRS-G900/1800 includes a GSM 900/1800 MHz module and every integrated modem referenced ModemModule GSM/GPRS-G850/1900 includes a GSM 850/1900 MHz module. These two dual-band modems have the same specifications unless otherwise specified.

AT Command Info

AT commands for the GSM/GPRS wireless modem are published in a separate Reference Guide included on the product CD and posted on the Multi-Tech web site.

GSM/GPRS IP commands are also published in a separate Reference Guide included on the product CD and posted on the Multi-Tech web site.

General Characteristics

General

- GPRS Class 10
- Dual Band GSM/GPRS modem E-GSM 900/1800 or GSM 850/1900
- 2W at 850MHz
- 1W at 1800/1900 MHz
- GSM Class 1 and Class 2 Group 3 FAX
- Small size and low power consumption
- Voice and Short Message Services (SMS)
- Fax and data transmission without extra hardware
- Serial interface supports DTE speeds up to 115.2K
- MMCX connector and SIM socket
- 14.4K GSM circuit-switched data
- Tricodec (FR/EFR/HR)
- Internal 3V SIM interface
- Easy remote control by AT commands for dedicated applications
- Fully Type Approved according to GSM Phase 2+ specifications
- Board-to-board or board-to-cable mounting
- Fully shielded and ready-to-use
- Packet-switched data up to 85K bps
- Circuit-switched data (GSM) up to 14.4K bps transparent and non-transparent
- Embedded TCP/IP stack
- MNP2, V.42bis data compression

Electrical

- Power supply: 5 VDC +/- 5% 1A

Mechanical

- Absolute maximum dimension: 46 x 64 x 12 mm
- Weight: 79 g
- Casing: Complete shielding-stainless steel/zinc
- Mounting: 4 screw holes
- Operating temperature range: -30°C to +70°C
- Storage temperature: -35°C to +85°C

Feature Details

Telephony

- Telephony (TCH/FS) & Emergency calls
- Full Rate, Enhanced Full Rate and Half Rate
- Dual Tone Multi Frequency function (DTMF)

Short Message Service (GSM and GPRS mode)

- Text and PDU
- Point to point MT & MO
- SMS Cell Broadcast

GSM Circuit Data Features

- Data circuit asynchronous, transparent and non transparent up to 14,400 bits/s
- Automatic fax group 3 (Class 1 & 2)
- Alternate speech and fax
- MNP2, V.42bis data compression

GPRS Packet Data Features

- GPRS Class 10
- Coding Schemes: C1S1 to CS4

GSM Supplementary Services

- Call Forwarding
- Call Barring
- Multiparty
- Call Waiting and Call Hold
- Calling Line Identity
- Advice of Charge
- USSD
- Closed User Group
- Explicit Call Transfer

Other Features

- ME+SIM phone book management
- Fixed Dialing Number
- SIM Toolkit Class 2
- SIM, network and service provider locks
- Real Time Clock
- Alarm management
- UCS2 character set management

Interfaces

Single antenna interface

Internal SIM interface: 3V only

External SIM interface: 3V or 5V

For Data Operation:

Serial link

Remote control by AT commands (GSM 07.07 and 07.05)

Baud rate from 300 to 115,200 bits/s

The integrated modem has a sole 50-pin connector, which gathers all the interface signals in order to facilitate its integration. It has an integrated SIM cardholder as well as a standard RF connector type MMCX. The concept of the integrated modem has been defined to integrate on a sole device:

- a single connector has been used that is standard and easy to find (it is supplied worldwide); this connector includes all of the modem's analog and digital connections
- One standard easy to find RF connector. See RF connector section in *Chapter 3: Electrical Characteristics*;
- One SIM card holder. See SIM section in *Chapter 3: Electrical Characteristics*.

Feature Descriptions

Integration Reduces Space, Power and Cost. The ModemModule GSM/GPRS integrates the controller, RF transceiver, and antenna interface in one compact unit. This integration requires low power, occupies very little space, and provides an overall reduction in costs.

Reduces Development Time. The ModemModule GSM/GPRS can make your existing and next generation device, machine, or system, communication-ready without requiring significant hardware changes to its design. It actually provides faster time-to-market because it relieves the burden and expense of obtaining network and RF approvals. This complete, ready-to-integrate wireless module allows you to enhance your product while you focus on developing its core features.

Voice Features. The ModemModule GSM/GPRS provides telephony and Dual Tone Multi Frequency (DTMF) functionality. It also allows for emergency calls as well as full rate, enhanced Full Rate and Half Rate (FR/EFR/HR).

Short Message Services. The ModemModule GSM/ GPRS offers SMS features such as text and PDU, point-to-point (MT/MO) and cell broadcast.

Compatible Supplementary Services. The ModemModule GSM/GPRS is compatible with supplementary services such as call forwarding, call barring, multiparty, call waiting and call hold, calling line identification, advice of charge, USSD, closed user group and explicit call transfer.

Management Features. The ModemModule GSM/ GPRS provides advanced management features including phone book management, fixed dialing number, real time clock and alarm management.

Industry-Standard Modem Commands. The ModemModule GSM/GPRS provides industry-standard AT-style commands for ease of integration into your existing software application.

ModemModule Pin-Out. The ModemModule GSM/ GPRS interfaces easily with existing products through a standard serial communication channel. The complete on-board RF transceiver interfaces with an antenna for direct connection to wireless SMS, circuit-switched dial-up, or packet data networks. The ModemModule is a Data Terminal Equipment (DTE) device with serial asynchronous protocol support. The serial DTE channel is capable of transfer speeds to 115.2K bps and can be interfaced directly to a UART or microcontroller. It can be board-to-board or board-to-cable mounted.

Developer's Kit. The ModemModule GSM/GPRS Developer's Kit allows you to plug in the ModemModule and use it for testing, programming and resolving application issues.

Packet-Switched Data. The ModemModule GSM/GPRS supports GPRS Class 10 packet-switched cellular data. This enables mobile Internet functionality by allowing interworking between the existing Internet and the cellular network at speeds up to 85K bps. Any service that is used over the fixed Internet today – File Transfer Protocol (FTP), web browsing, chat, e-mail, telnet -- is available over the cellular network, as well. The MultiModem GSM/GPRS supports PBCCH and coding schemes CS1 to CS4, and is compliant with SMG31bis.

Circuit-Switched Data (CSD). The ModemModule GSM/GPRS also supports GSM circuit-switched cellular data connections. Circuit-switched data connections support speeds up to 14.4K bps, Class 1 and Class 2 Group 3 fax, as well as MNP2 V.42bis compression. CSD cellular wireless connections are ideal for applications that require a quick wireless replacement of an existing point-to-point analog dial-up connection. They integrate seamlessly with your current application requiring little infrastructure change.

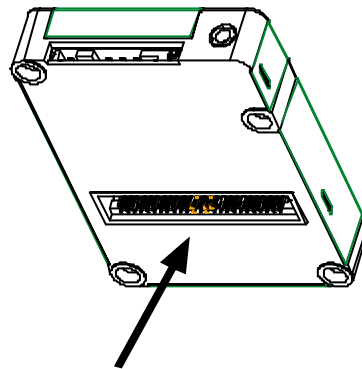
Applications

With circuit switched data rates up to 14.4K bps, the MultiModem GSM/GPRS is targeted at applications that periodically need to send or receive data over a wireless network. It is an ideal device for:

Appliances	Remote Diagnostics
ATM Terminals	Remote Metering
Automotive	Security Systems
Data Collection	Vending/Gaming Machines
Gas Pumps	Other devices requiring wireless connectivity.
Industrial and Medical Remote Monitoring Systems	Note: The Wireless MultiModem must be mounted with at least 8 inches (20 cm) of clearance from the human body.

Mechanical Design Overview

The ModemModule is encased as shown in the figure below. It includes an RF module, a 50-pin connector, a SIM holder and an RF connector.



Interface Connector

Figure 1-2: Mechanical Description A

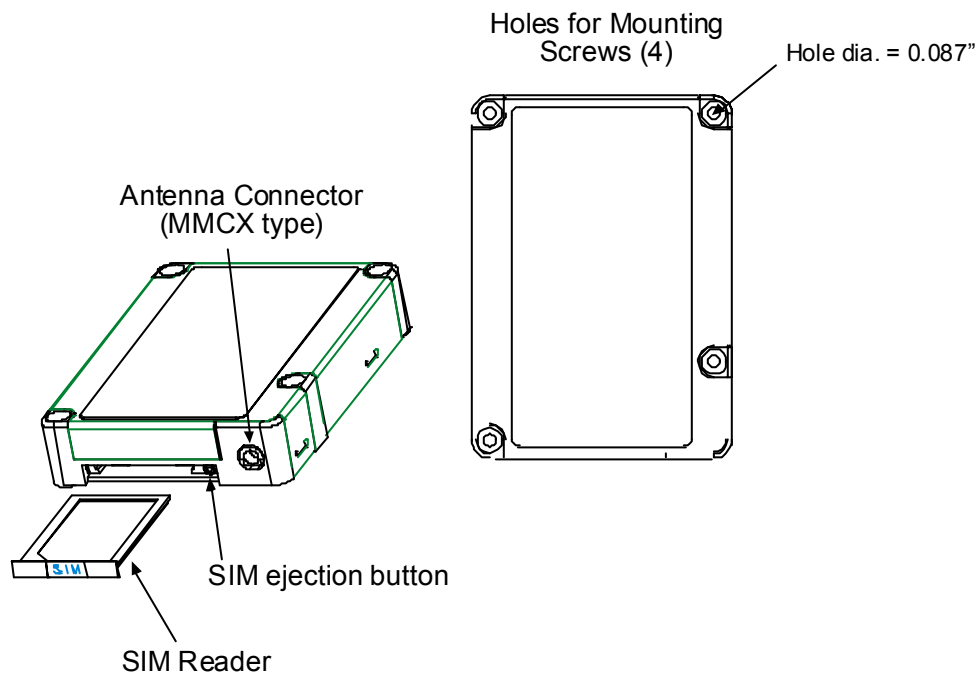
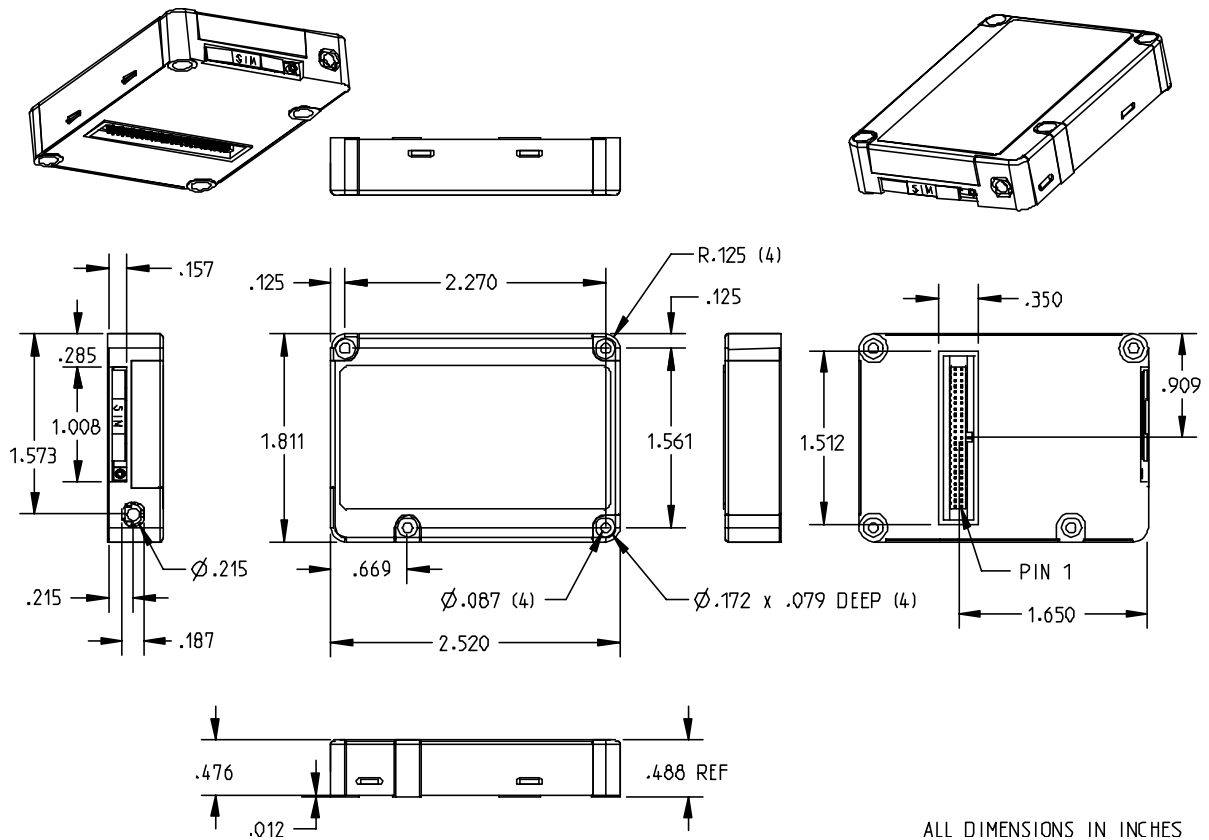


Figure 1-3: Mechanical Description B

Four screw holes allow the ModemModule to be fixed on the mother PCB. The ModemModule can be mounted indifferently on both sides (top or bottom). For further details see *Chapter 2: Mechanical Specifications*.

Chapter 2 – Mechanical Specifications

Mechanical Dimensions



ALL DIMENSIONS IN INCHES

Figure 2-1: ModemModule Dimensions

Climatic and Mechanical Environment Testing Compliance

Table 2-1: Climatic and Mechanical Environment Testing Compliance

<i>G900/G1800</i>		<i>Environmental</i>		
Type of Test	Standards	Storage Class 1.2	Transportation Class 2.3	Operating (Port Use) Class 7.3
Cold	IEC 68-2.1 Ab test	-25 ⁰ C; 72 hours	-40 ⁰ C; 72 hours	-20 ⁰ C (GSM); 16 hours -10 ⁰ C (DCS) 16 hours
Dry Heat	IEC 68-2.2 Bb test	+70 ⁰ C; 72 hours	+70 ⁰ C; 72 hours	+55 ⁰ C; 16 hours
Change of Temperature	IEC 68-2.14; Na/Nb test		-40 ⁰ /+30 ⁰ C; 5 cycles t1 = 3 hours	-20 ⁰ /+30 ⁰ C (GSM); 3 cycles -10 ⁰ /+30 ⁰ C (DCS); 3 cycles t1 = 3 hours
Damp Heat Cyclic	IEC 68-2.30; Db test	+30 ⁰ C; 2 cycles 90% - 100% RH variant 1	+40 ⁰ C; 2 cycles 90% - 100% RH variant 1	+40 ⁰ C; 2 cycles 90% - 100% RH variant 1
Damp Heat	IEC 68-2.56 Cb test	+30 ⁰ C; 4 days	+40 ⁰ C; 4 days	+40 ⁰ C; 4 days
Sinusoidal Vibration	IEC 68-2.6 Fc test	5 - 62 Hz : 5 mm/s 62 – 200 Hz: 2 m/s ² 3 x 5 sweep cycles		
Random Vibration	IEC 68-3.36 Fdb test		5 – 20 Hz: 0.96 m ² /s ³ 20 – 500 Hz: -3 dB/ oct 3 x 10 min	10 – 12 Hz: 0.96 m ² /s ³ 12 – 150 Hz: -3 dB/ oct 3 x 30 min

Chapter 3 – Electrical Characteristics

Introduction

This chapter describes the electrical interface of the MultiModem. These are:

- interfaces on the 50-pin general purpose connector (power and data/signaling)
- RF interface
- SIM interface

50-Pin Connector Interfaces

50-Pin Connector Description

Table 3-1. 50-pin Connector Description

<i>Pin #</i>	<i>Name</i>	<i>I/O</i>	<i>I/O Type</i>	<i>Description</i>	<i>Comment</i>
1	GND			GROUND	High current
2	GND			GROUND	High current
3	+5V		Supply		High current
4	+5V		Supply		High current
5	CT109/DCD	O	CMOS/2X	Data Carrier Detect	
6	GND			GROUND	High current
7	GPI04	I/O	CMOS/2X	General Purpose I/O	
8	SPK2N	O	Analog	Speaker 2 negative output	
9	CT125/RI	O	CMOS/2X	Ring Indicator	
10	SPK2P	O	Analog	Speaker 2 positive output	
11	Flashing LED	I/O	CMOS/2X	Working mode indication LED	Driven by module
12	SPK1P	O	Analog	Speaker 1 positive output	
13	CT106/CTS	O	1X	Clear to Send	
14	SPK1N	O	Analog	Speaker 1 negative output	
15	ON/~OFF	I		Power ON/OFF control	ON = Vcc
16	MIC2P	I	Analog	Microphone 2 positive input	
17	AUXV0	I	Analog	Auxiliary ADC input	
18	MIC2N	I	Analog	Microphone 2 negative input	
19	~RST	I		Reset active low	Open Collector
20	MIC1P	I	Analog	Microphone 1 positive input	
21	GND	I		Ground	
22	MIC1N	I	Analog	Microphone 1 negative input	
23	BOOT	I		BOOT	Open Collector
24	GND			GROUND	High Current
25	CT103/TX	I		Transmit Data	

Table 3-1. 50-Pin Connector Description (Continued)

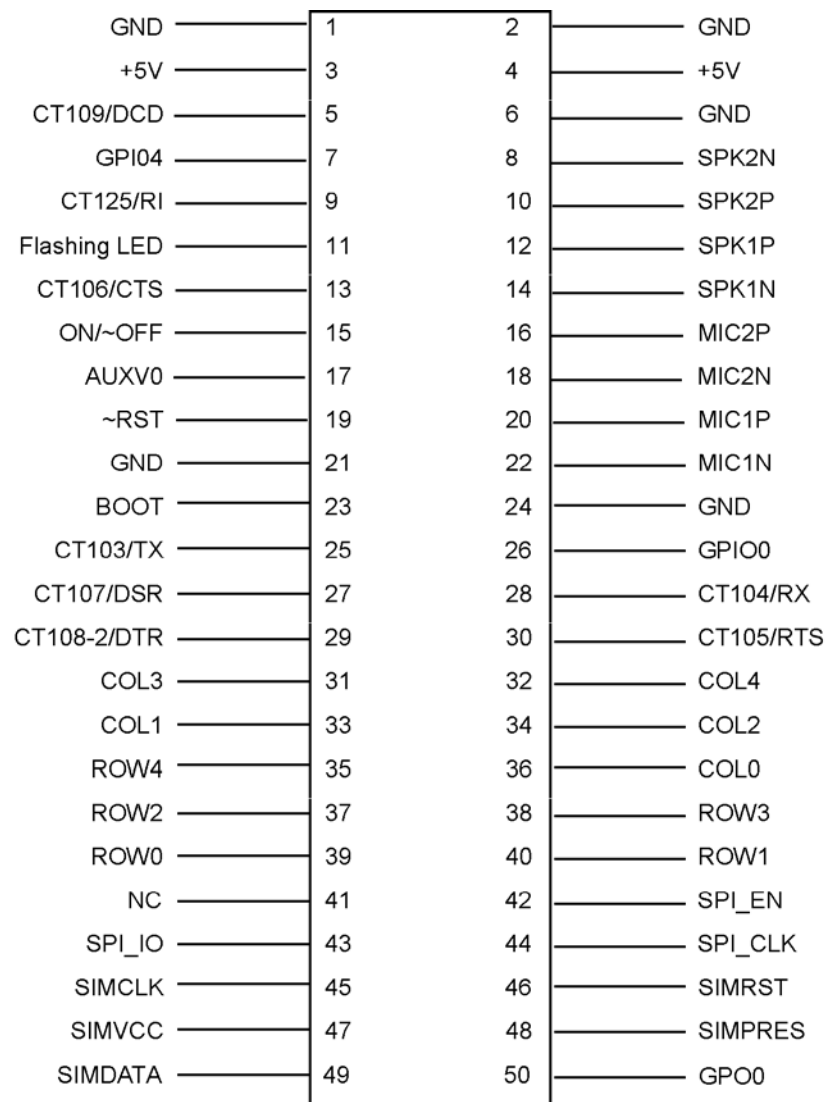
Pin #	Name	I/O	I/O Type	Description	Comment
26	GPI00	I/O	CMOS/2X	General Purpose I/O	
27	CT107/DSR	O	1X	Data Set Ready	
28	CT104/RX	O	1X	Receive Data	
29	CT108-2/DTR	I		Data Terminal Ready	
30	CT105/RTS	I		Request to Send	
31	COL3	I/O	1X	Keypad column	
32	COL4	I/O	1X	Keypad column	
33	COL1	I/O	1X	Keypad column	
34	COL2	I/O	1X	Keypad column	
35	ROW4	I/O	1X	Keypad row	
36	COL0	I/O	1X	Keypad column	
37	ROW2	I/O	1X	Keypad row	
38	ROW3	I/O	1X	Keypad row	
39	ROW0	I/O	1X	Keypad row	
40	ROW1	I/O	1X	Keypad row	
41	NC			Not Connected	
42	SPI_EN	O	1X	SPI enable	
43	SPI_IO	I/O	1X	I ² C Data or SPI Data	
44	SPI_CLK	O	2X	I ² C Clock or SPI Clock	
45	SIMCLK	O	2X	Clock for SIM interface	3V mode
46	SIMRST	O	2X	Reset for SIM interface	3V mode
47	SIMVCC	O		SIM card supply	3V mode 6mA max.
48	SIMPRES	I		SIM card detect	Connected to SIM connector pin 8. Pin 4 of SIM connector must be pulled down to GND with 1 K-Ohm*
49	SIMDATA	I/O	3X	I/O for SIM interface	3V mode
50	GPO0			General purpose I/O	

* See SIM socket diagram in SIM interface section

** GPO0 is a general purpose output for selection of external SIM, 3V or 5V.

Table 3-2. Operating Conditions

Parameter	I/O Type	Min	Max	Condition
$V_{\text{input low}}$	CMOS	-0.5V	0.8V	
$V_{\text{input high}}$	CMOS	2.1V	3.0V	
$V_{\text{output low}}$	1X		0.2V	$I_{\text{OL}} = -1\text{mA}$
	2X		0.2V	$I_{\text{OL}} = -2\text{mA}$
	3X		0.2V	$I_{\text{OL}} = -3\text{mA}$
$V_{\text{output high}}$	1X	2.6V		$I_{\text{OH}} = 1\text{mA}$
	2X	2.6V		$I_{\text{OH}} = 2\text{mA}$
	3X	2.6V		$I_{\text{OH}} = 3\text{mA}$

**Figure 3-1: 50-Pin Connector**

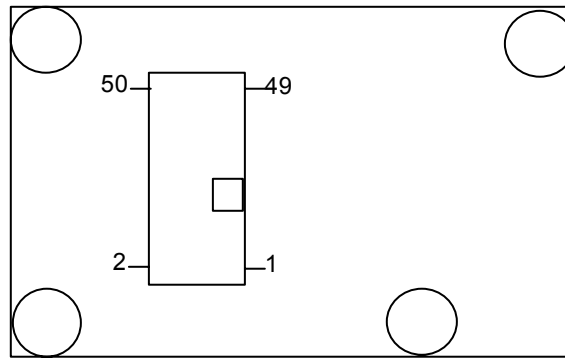


Figure 3-2: Pin Numbering – Bottom View

Power Supply

The main power supply is provided through a double connection. These connections are respectively pins 3 and 4 for the +5V and the pins 1 and 2 for the ground (GND). The pins 6, 21, and 24 are also ground connection in order to produce a proper ground plane.

A 5V +/-5% - 1.3A power is strictly required to supply the modem. However, the modem does not have to constantly deliver 1.3A current at 5V on this power supply.

This power supply is internally regulated to a nominal value VBATT.

Table 3-3: Power Supply Pin Description

<i>Pin Number</i>	<i>Name</i>	<i>Description</i>	<i>Comment</i>
1	GND	Ground	High Current
2	GND	Ground	High Current
3	+5V	Ground	High Current
4	+5V	Ground	High Current
6	GND	Ground	High Current
21	GND	Ground	High Current
24	GND	Ground	High Current

Table 3-4: Power Consumption in EGSM900 and GSM850 @25 degrees C

	Conditions	I_{NOM}	I_{MAX}
+5V	During TX bursts @2W	1.2 A	1.3 A
+5V	Average @ 2W	250 mA	320 mA
+5V	Average @ .5W	180 mA	200 mA
+5V	Average idle mode	15 mA	25 mA

Table 3-5: Power Consumption in GSM1800 & 1900 MHz @25 degrees C

	Conditions	I _{NOM}	I _{MAX}
+5V	During TX bursts @1W	1.1 A	1.2 A
+5V	Average @1W	210 mA	235 mA
+5V	Average @ 0.25W	165 mA	185 mA
+5V	Average idle mode	15 mA	25 mA

Table 3-6: Power Consumption in EGSM/GPRS 900 MHz and GSM/GRPS 850 MHz Mode**Class 10**

	Conditions	I _{NOM}	I _{MAX}
+5V	During TX bursts @ 2W	1.2 A	1.3 A
+5V	Average @ 2W	420 mA	470 mA
+5V	Average @ 0.5W	280 mA	320 mA
+5V	Average idle mode	15 mA	25 mA

Table 3-7: Power Consumption in GSM/GRPS 1800 MHz and GSM/GRPS 1900 MHz**Class 10**

	Conditions	I _{NOM}	I _{MAX}
+5V	During TX bursts @ 1W	1.1 A peak	1.2 A peak
+5V	Average @ 1W	350 mA	400 mA
+5V	Average @ .25W	180 mA	210 mA
+5V	Average idle mode	15 mA	25 mA

Serial Link

A serial link interface is available complying with V24 protocol signaling but not with V28 (electrical interface) due to a 2.8 Volts interface. TX, RTS and DTR can be either 5V or 3V. Data signals are Hi = Mark. Controls signals are Hi = Off.

The signals are Tx data (CT103/TX), Rx data (CT104/RX), Request To Send (CT105/RTS), Clear To Send (CT106/CTS), Data Terminal Ready (CT108-2/DTR), Data Carrier Detect (CT109/DCD), Ring Indicator (CT125/RI), and Data Set Ready (CT107/DSR).

Table 3-8: Serial Link Pin Description

<i>Signal</i>	<i>Pin Number</i>	<i>I/O</i>	<i>I/O Type*</i>	<i>Description</i>
CT103 / TX	25	I	CMOS	Transmit serial data
CT104 / RX	28	O	1X	Receive serial data
CT105 / RTS	30	I	CMOS	Ready to send
CT106 / CTS	13	O	1X	Clear to send
CT107 / DSR	27	O	1X	Data set ready
CT108-2 / DTR	29	I	CMOS	Data terminal ready
CT109 / DCD	5	O	CMOS / 2X	Data carrier detect
CT125 / RI	9	O	CMOS / 2X	Ring indicator

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

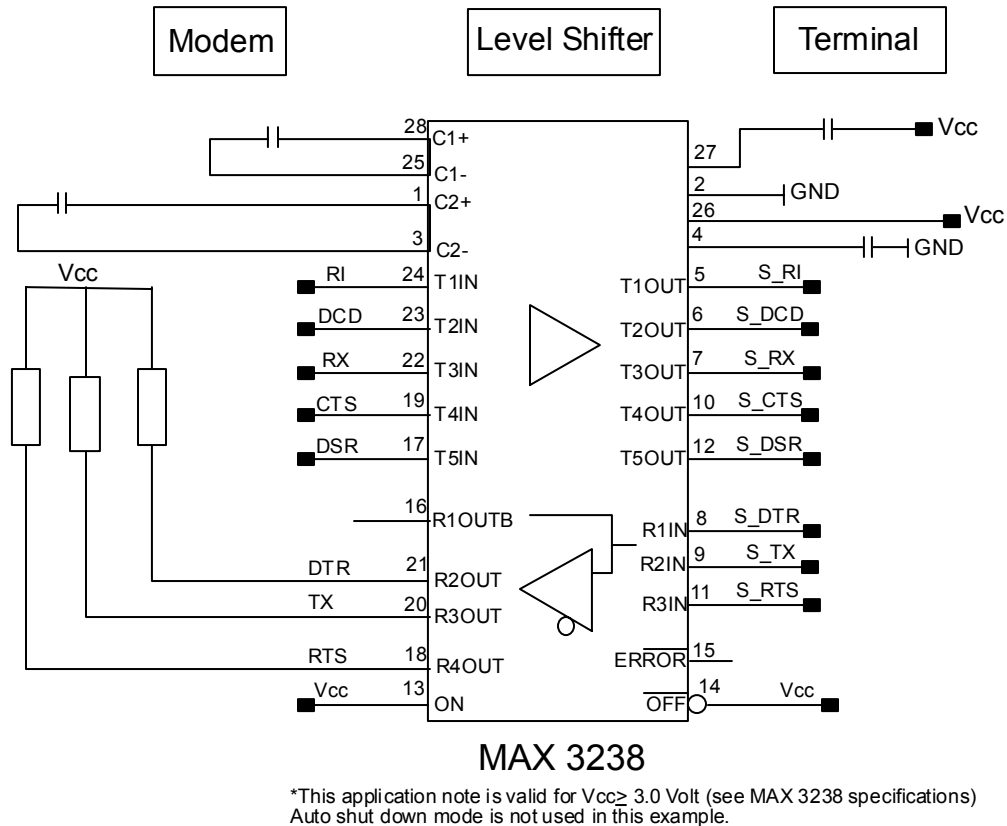


Figure 3-3: Level Shifter Application Diagram for Serial Link

ON / ~OFF Interface

This input is used to switch ON or OFF the ModemModule. A high level signal has to be provided on the ON/~OFF pin to switch on the modem. The level of the voltage of this signal has to be maintained to VCC during a minimum time of 1 second. When powered off, the shutdown current is roughly 60 microamperes.

Table 3-9: ON / OFF Pin Description

<i>Signal</i>	<i>Pin Number</i>	<i>I/O</i>	<i>I/O Type</i>	<i>Description</i>
ON / ~OFF	15	I	CMOS	Module Power ON/OFF

Power OFF Procedure

In order to power OFF the ModemModule, switch it OFF both via software (AT+CPOF; see AT Command Manual for more details) and via hardware line. See the diagrams below.

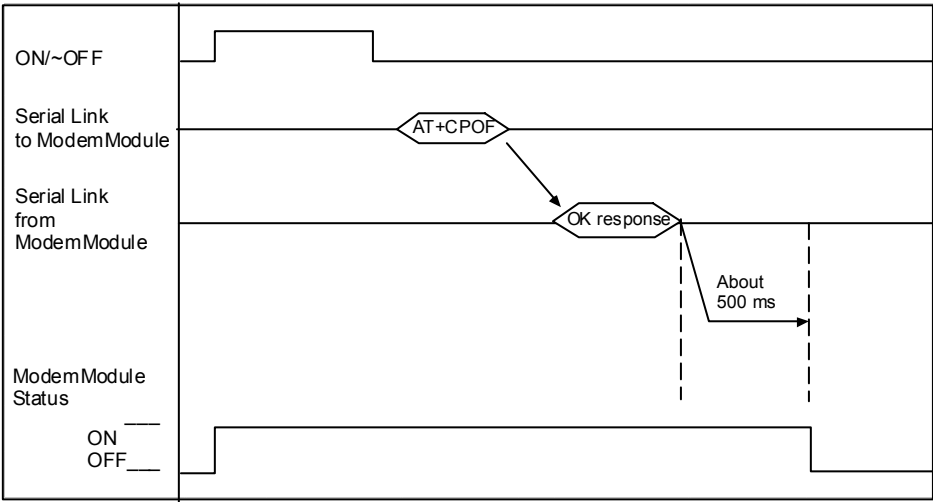


Figure 3-4: Power-Off Procedure 1

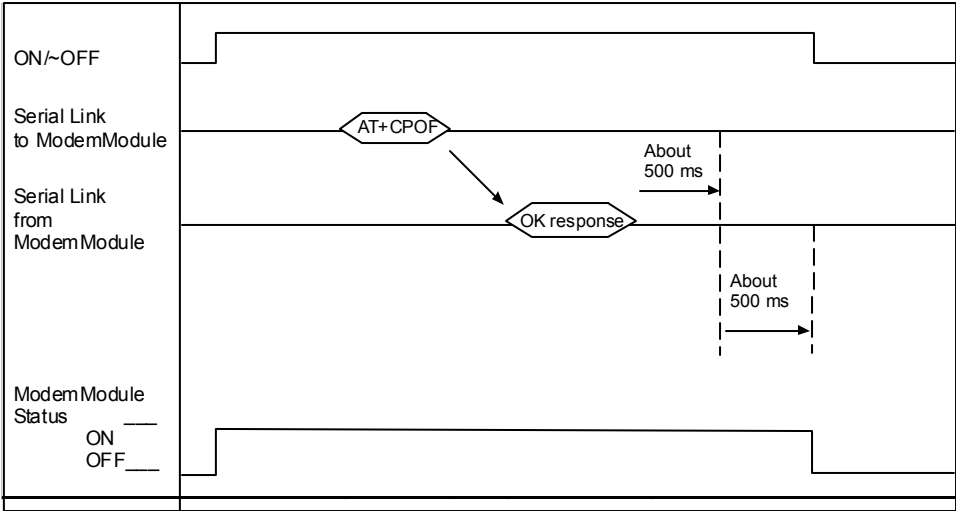


Figure 3-5: Power-Off Procedure 2

BOOT

This input is used to switch the ModemModule into download mode (backup procedure). The internal boot procedure is started when this pin is low during the power ON of the module. In normal mode, this pin has to be left open. If used, this input has to be driven by an open collector or an open drain. See below an example of application diagram. See also the “Firmware Upgrade” section of *Chapter 5: Application Considerations*.

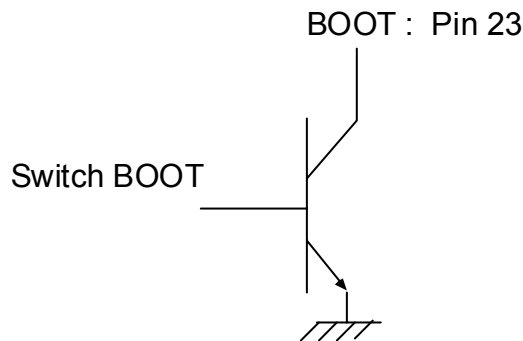


Figure 3-6: Boot Procedure

If Switch Boot = 1, Boot pin 23 = 0, to download mode
If Switch Boot = 0, Boot pin 23 = 1, to normal mode

Table 3-10: BOOT Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
BOOT	23	I	CMOS	SW downloading

* See “Table 3-2: Operating Conditions” in section on the *50-pin Connector Description*.

Reset Signal (~RST)

This signal is used to force a reset of the ModemModule. It has to be used by providing low level during approximately 2ms. This signal has to be considered as an emergency reset only. A reset procedure is already driven by an internal hardware during the power-up sequence.

This signal can also be used to provide a reset to an external device. If no external reset is necessary this input can be left open. If used (emergency reset), it has to be driven by an open collector or an open drain. See below an example of application diagram.

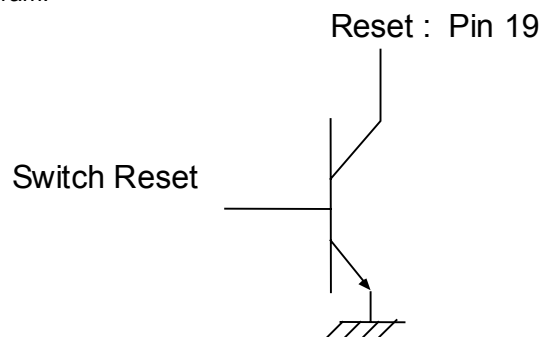


Figure 3-7: Reset Procedure

If switch Reset = 1, Reset pin 19 = 0
If switch Reset = 0, Reset pin 19 = 1

Table 3-11: Reset Signal Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
~RST	19	I/O		Module reset

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Table 3-12: Reset Signal Electrical Characteristics

Parameter	Min	Max	Unit
Input Impedance (R)	4.7		kilo-ohms
Input Impedance (C)		10	nanofarads

Table 3-13: Reset Signal Operating Conditions

Parameter	Min	Max	Condition
*V _{T-}	1.1 V	1.2 V	
*V _{T+}	1.7 V	1.9 V	
V _{OL}		0.4 V	I _{OL} = -50 microamperes
V _{OH}	2.0 V		I _{OH} = -50 microamperes

V_{T-}, V_{T+} hysteresis level

Flashing LED

The flashing LED signal is used to indicate the working mode of the ModemModule.

Table 3-14: Flashing LED Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
Flashing LED	11	I/O	CMOS/2X	Working mode indication LED

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Table 3-15: LED and ModemModule Status

LED Indication	ModemModule Status	
OFF	Download mode or switched OFF.	
ON	Permanent	Switched ON, not registered on the network.
	Flash	Switched ON, registered on the network.

General Purpose Input/Output

The ModemModule provides two General Purpose I/O connections. They can be used to control any external device.

Table 3-16: General Purpose I/O Pin Description

Signal	Pin Number	I/O	I/O Type*	Description	Default Value
GPIO0	26	I/O	CMOS / 2X	General Purpose I/O	0
GPIO4	7	I/O	CMOS / 2X	General Purpose I/O	0

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

All digital I/O complies with 3Volts CMOS.

You can access (write or read) the GPIO value via AT+WIOV and AT+WIOR. See AT Command manual for more details.

Analog to Digital Converter

The ModemModule has an Analog to Digital converter (ADC) input. This converter is 10 bits, ranging from 0 to 2.5V. You can see the measurements via AT+ADC. See AT Command manual for more details.

Table 3-17: A/D Converter Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
AUXV0	17	I	Analog	A/D converter

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Table 3-18: A/D Converter Electrical Characteristics

Parameter	Min	Max	Unit
Resolution	10		bits
Sampling Rate	90.3		Ksps
Input Signal Range	0	2.5V	Volts
ADC Reference Accuracy	0.5		%
Integral Accuracy	+/- 1		LSB
Differential Accuracy	+/- 1		LSB
Input Impedance (R)	10		meg-Ohms
Input Impedance (C)		50	pico-Farads

Audio Interface

Two different microphone inputs and two different speaker outputs are supported. The connection can be either differential or single-ended but using a differential connection in order to reject common mode noise and TDMA noise is recommended.

Microphone 2 Inputs

The MIC2 inputs are differential ones. They already include the convenient biasing for an electret microphone (0,5 mA and 2 Volts). This electret microphone can be directly connected on these inputs. The impedance of the microphone 2 has to be around 2K. These inputs are the standard ones for a handset design while MIC1 inputs can be connected to an external headset or a hands-free kit.

The gain of MIC2 inputs is internally adjusted. The gain can be tuned from 30dB to 51dB. The connection to the microphone is direct. The gain can be tuned using the AT+VGR command. See *Appendix B: Sourcing Connectors and Peripheral Devices*.

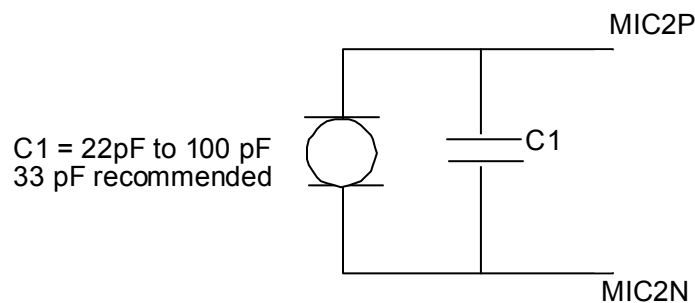


Figure 3-8: Microphone 2 Input

C1 has to be the nearest as possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

Table 3-19: Microphone 2 Input Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
MIC2P	16	I	Analog	Microphone 2 positive input
MIC2N	18	I	Analog	Microphone 2 negative input

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Microphone 1 Inputs

The MIC1 inputs are differential and do not include internal bias. To use these inputs with an electret microphone, bias has to be generated outside the ModemModule according to the characteristic of this electret microphone. These inputs are the standard ones used for an external headset or a hands-free kit. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path. The gain of MIC1 inputs is internally adjusted. The gain can be tuned from 30dB to 51dB.

The gain can be tuned using the AT+VGR command.

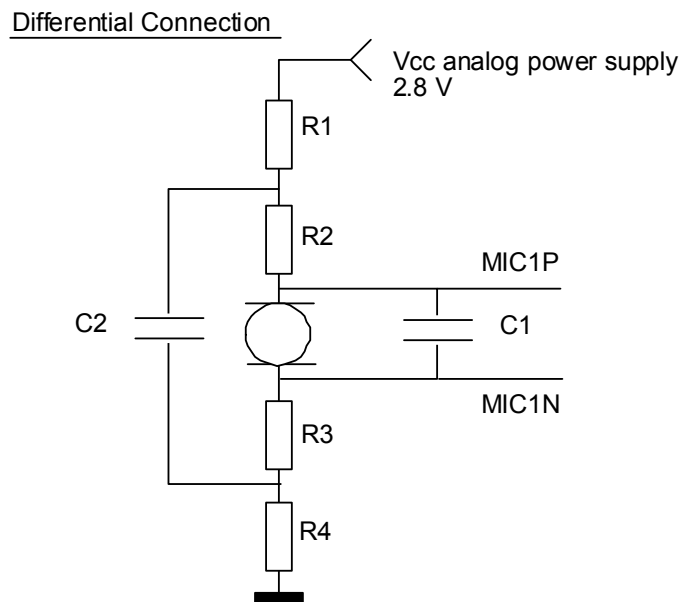


Figure 3-9: Microphone 1 Input

R1 = R4 = from 100 to 330 .

R2 = R3 = usually between 1K and 3.3K as per the microphone characteristics

C1 = 22pF to 100pF

C2 = 47μF

R1 and R4 are used as a voltage supply filter with C2.

C1 has to be the nearest possible to the microphone. Microphone manufacturers provide this capacitor directly soldered on the microphone.

Table 3-20: Microphone 1 Input Pin Description

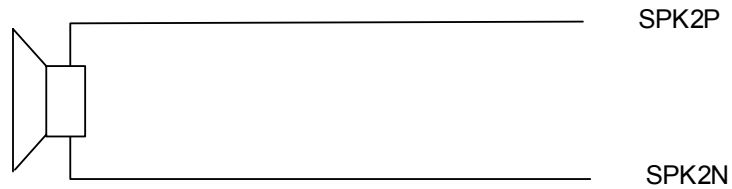
Signal	Pin Number	I/O	I/O Type*	Description
MIC1P	20	I	Analog	Microphone 1 positive input
MIC1N	22	I	Analog	Microphone 1 negative input

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Speaker 2 Outputs

Speaker outputs SPK2 are push-pull amplifiers and can be loaded down to 50 Ohms and up to 1nF. These outputs are differential and the output power can be adjusted by step of 2dB. The output can be directly connected to a speaker. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as shielding in order to avoid any disturbance on the audio path.

Differential Connection



Single-Ended Connection

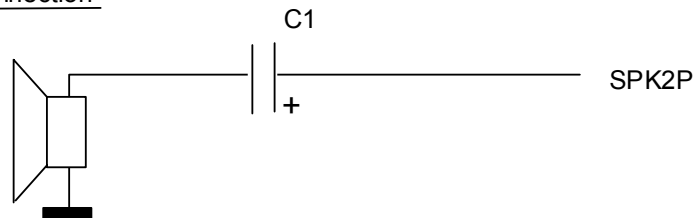


Figure 3-10: Speaker 2 Output

C1 = from 100nF to 47μF as per the speaker characteristics and the output power.

Using a single-ended connection also includes losing half of the output power compared to a differential connection.

Table 3-21: Speaker 2 Output Pin Description

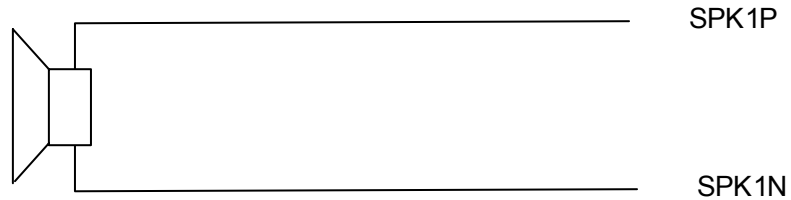
Signal	Pin Number	I/O	I/O Type*	Description
SPK2P	10	O	Analog	Speaker 2 positive output
SPK2N	8	O	Analog	Speaker 2 negative output

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Speaker 1 Outputs

Speaker outputs SPK1 are push-pull amplifiers and can be loaded down to 50 Ohms and up to 1nF. These outputs are differential and the output power can be adjusted by step of 2dB. The output can be directly connected to a speaker. When using a single-ended connection, be sure to have a very good ground plane, a very good filtering as well as a shielding in order to avoid any disturbance on the audio path.

Differential Connection



Single-Ended Connection

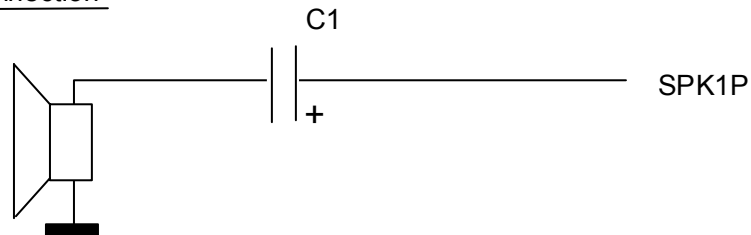


Figure 3-11: Speaker 1 Output

C1 = from 100nF to 47μF as per the speaker characteristics.

Using a single-ended connection also includes losing half of the output power compared to a differential connection.

Table 3-22: Speaker 1 Output Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
SPK1P	12	O	Analog	Speaker 1 positive output
SPK1N	14	O	Analog	Speaker 1 negative output

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

SIM interface

The external SIM interface is available through the 50-pin connector in order to use a stand-alone SIM cardholder. 5V SIMs can be driven using an external level shifter.

SIM line must not exceed 15 cm. See also the “Hardware and RF” section of *Chapter 5: Application Considerations*.

Five signals are available:

SIMVCC: SIM power supply.

SIMRST: reset.

SIMCLK: clock.

SIMDATA: I/O port.

SIMPRES1 SIM card detect. This signal is connected to the external SIM connector on pin 8. Pin 4 of SIM connector must be pulled down to GND with 1 K.

This interface is fully compliant with GSM 11.11 recommendations concerning the SIM functionality.

Transient Voltage Suppressor diodes are internally added on the signals connected to the SIM socket in order to prevent any Electro-Static Discharge. TVS diodes with low capacitance (less than 10pF) are connected on SIMCLK and SIMDATA to avoid any disturbance of the rising and falling edge.

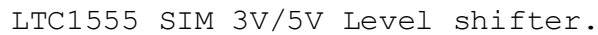
Table 3-23: SIM Interface Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
SIMCLK	45	O	2X	SIM Clock
SIMRST	46	O	2X	SIM Reset
SIMDATA	49	I/O	CMOS/2X	SIM Data
SIMVCC	47	O		SIM Power Supply
SIMPRES1	48	I	CMOS	SIM Card Detect
GPO0	50	O	2X	SIM 3V or 5V

* See “Table 3-2: Operating Conditions” in section on the *50-pin Connector Description*.

30

R20, R21, R22 and R23 are used to shunt LTC1555.



SIM Schematic

Table 3-24: SIM Interface Electrical Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
SIMDATA V_{IH}	$I_{IH} = +/- 20\mu A$	$0.7 \times SIMVCC$			V
SIMDATA V_{IL}	$I_{IL} = 1 \text{ mA}$			$0.3 \times SIMVCC$	V
SIMRST, SIMDATA SIMCLK V_{OH}	Source current $= 20\mu A$	$SIMVCC - 0.1V$			V
SIMRST, SIMDATA SIMCLK V_{OL}	Sink current $= -200\mu A$			0.1	
SIMVCC Output Voltage	$I_{SIMVCC} \leq 6mA$	2.70	2.80	2.85	V
SIMCLK Rise/Fall Time	Loaded with 30pF			50	ns
SIMRST, SIMDATA Rise/Fall Time	Loaded with 30pF			1	μs
SIMCLK Frequency	Loaded with 30pF			3.25	MHz

Table 3-25: SIM Socket Pin Description

Signal	Pin Number	Description
Vcc	1	SIMVCC
RST	2	SIMRST
CLK	3	SIMCLK
CC4	4	R10 to Ground
GND	5	Ground
VPP	6	not connected
I/O	7	SIMDATA
CC8	8	SIMPRES1

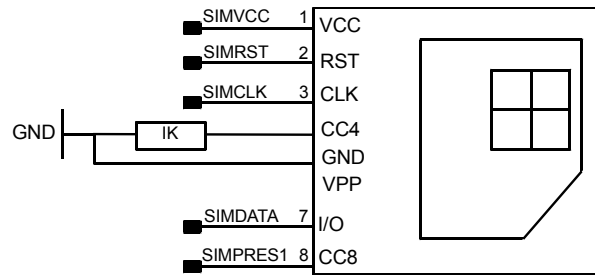


Figure 3-12: SIM Socket

SPI Bus

The SPI bus includes a CLK signal, an I/O signal and an EN signal complying with SPI bus standard. The maximum speed transfer is 3.25Mb/s.

Table 3-26 : SPI Bus Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
SPI_CLK	44	O	1X	SPI Serial Clock
SPI_IO	43	I/O	CMOS/1X	SPI Data
SPI_EN	42	O	1X	SPI Enable

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Keypad Interface

This interface provides 10 connections: 5 rows (R0 to R4) and 5 columns (C0 to C4).

The scanning is a digital one, and the de-bouncing is done in the integrated modem. No discrete components like R, C (Resistor, Capacitor) are needed. It is possible to scan the column and rows using the AT+CMER command. See AT Command manual for more details.

Table 3-27: Keypad Interface Pin Description

Signal	Pin Number	I/O	I/O Type*	Description
ROW0	39	I/O	CMOS / 1X	Row scan
ROW1	40	I/O	CMOS / 1X	Row scan
ROW2	37	I/O	CMOS / 1X	Row scan
ROW3	38	I/O	CMOS / 1X	Row scan
ROW4	35	I/O	CMOS / 1X	Row scan
COL0	36	I/O	CMOS / 1X	Column scan
COL1	33	I/O	CMOS / 1X	Column scan
COL2	34	I/O	CMOS / 1X	Column scan
COL3	31	I/O	CMOS / 1X	Column scan
COL4	32	I/O	CMOS / 1X	Column scan

* See "Table 3-2: Operating Conditions" in section on the *50-pin Connector Description*.

Chapter 4 – Interfaces

This chapter describes the ModemModule interfaces.

- Flashing LED
- SIM Interface
- RF Interface
- DTE/DCE Interface Rates

Flashing LED

The flashing LED signal is used to indicate the working mode of the ModemModule.

Table 4-1: LED and ModemModule Status

Signal	ModemModule Status	
OFF	Download mode or switched OFF>	
ON	Continuously lit	Switched ON (not registered on the network)
	Flashing	Switched ON (registered on the network)

SIM Interface

The internal SIM interface of the SocketModule supports 3V SIMs only.

Note: This interface is fully compliant with GSM 11.11 recommendations concerning the SIM functionality.

Five Signals Are Available

SIMVCC: SIM power supply.

SIMRST: reset.

SIMCLK: clock.

SIMDATA: I/O port.

SIMPRES1 SIM card detect.

RF Interface

The impedance is 50 Ohms nominal.

RF Connector

The RF connector is MMCX standard type. An antenna can be directly connected through the mating connector or using a small adapter.

RF Performances

RF performances are compliant with the ETSI recommendation 05.05 and 11.10.

The main parameters are:

Receiver:

- EGSM Sensitivity : < -104 dBm
- GSM 1800/GSM 1900 Sensitivity : < -102 dBm
- Selectivity @ 200 kHz : > +9 dBc
- Selectivity @ 400 kHz : > +41 dBc
- Dynamic range : 62 dB
- Intermodulation : > -43 dBm
- Co-channel rejection : + 9 dBc

Transmitter:

- Maximum output power (EGSM) : 33 dBm +/- 2 dB
- Maximum output power (DCS/PCS) : 30 dBm +/- 2 dB
- Minimum output power (EGSM): 5 dBm +/- 5 dB
- Minimum output power (DCS/PCS): 0 dBm +/- 5 dB
- H2 level : < -30 dBm
- H3 level : < -30 dBm
- Noise in 925 - 935 MHz : < -67 dBm
- Noise in 935 - 960 MHz : < -79 dBm
- Noise in 1805 - 1880 MHz : < -71 dBm
- Phase error at peak power : < 5 ° RMS
- Frequency error : +/- 0.1 ppm max

DTE/DCE Interface Rates

The table below indicates the anticipated modem-to-computer interface rates for both the 7.2 bits-per-sample rate and the 8 bits-per-sample rate.

Table 4-2: Projected DTE/DCE Interface Rates for 7.2/8K Hz Sample Rates

Bits per Sample	Projected DTE/DCE I/F Rate @ 7.2K Hz	Projected DTE/DCE I/F Rate @ 8K Hz Sample Rate
0.50	4800	9600
1	9600	19200
2	19200	19200
3	38400	38400
4	38400	57600
5	57600	57600
6	57600	115200
7	115200	115200
8	115200	115200
9	115200	115200
10	115200	115200
11	115200	115200
12	115200	Fast
13	Fast	Fast

Chapter 5 – Test Board

Serial Test/Demo Board Components

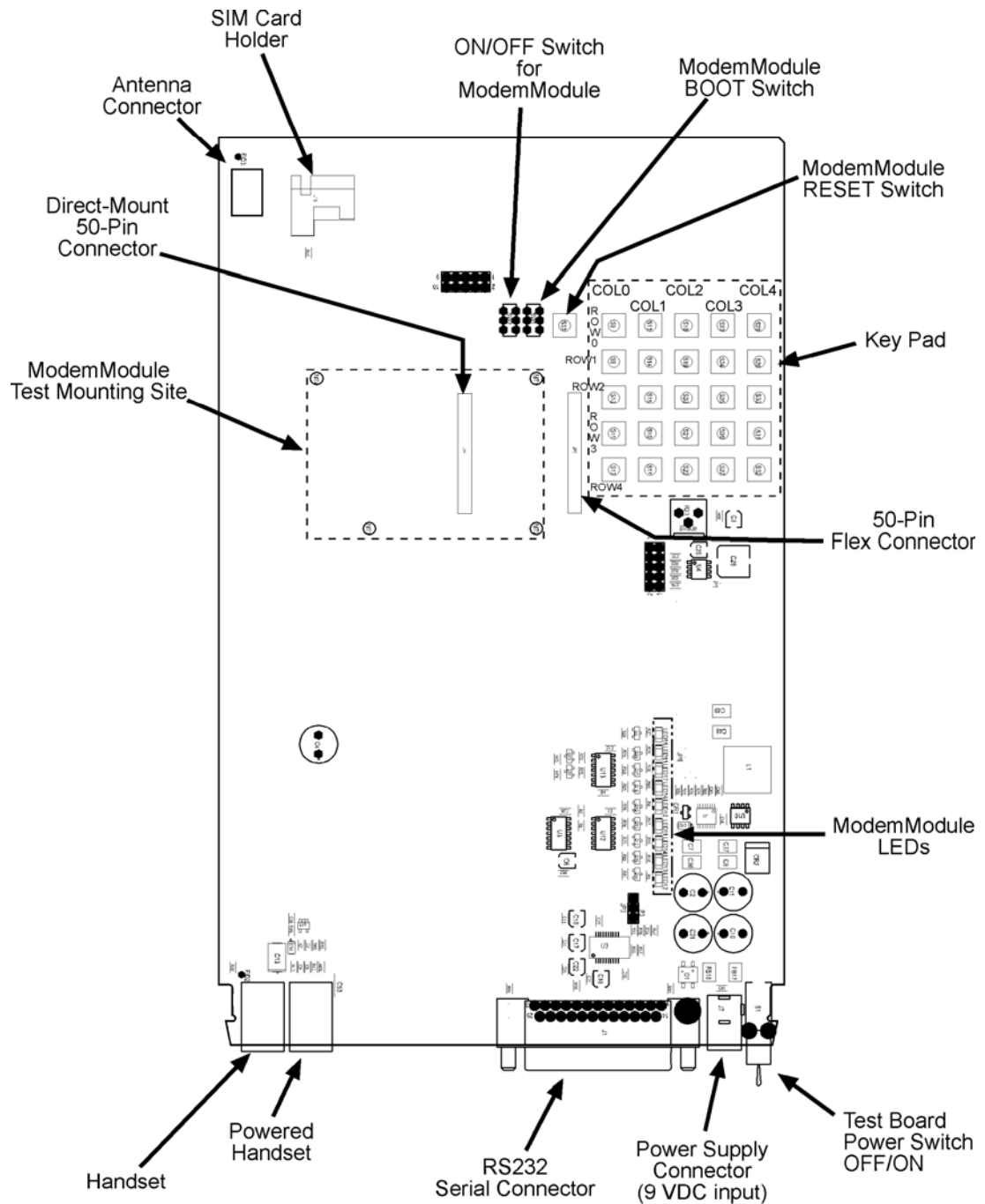


Figure 5-1: Serial Test/Demo Board Components

Serial Test/Demo Board Block Diagram

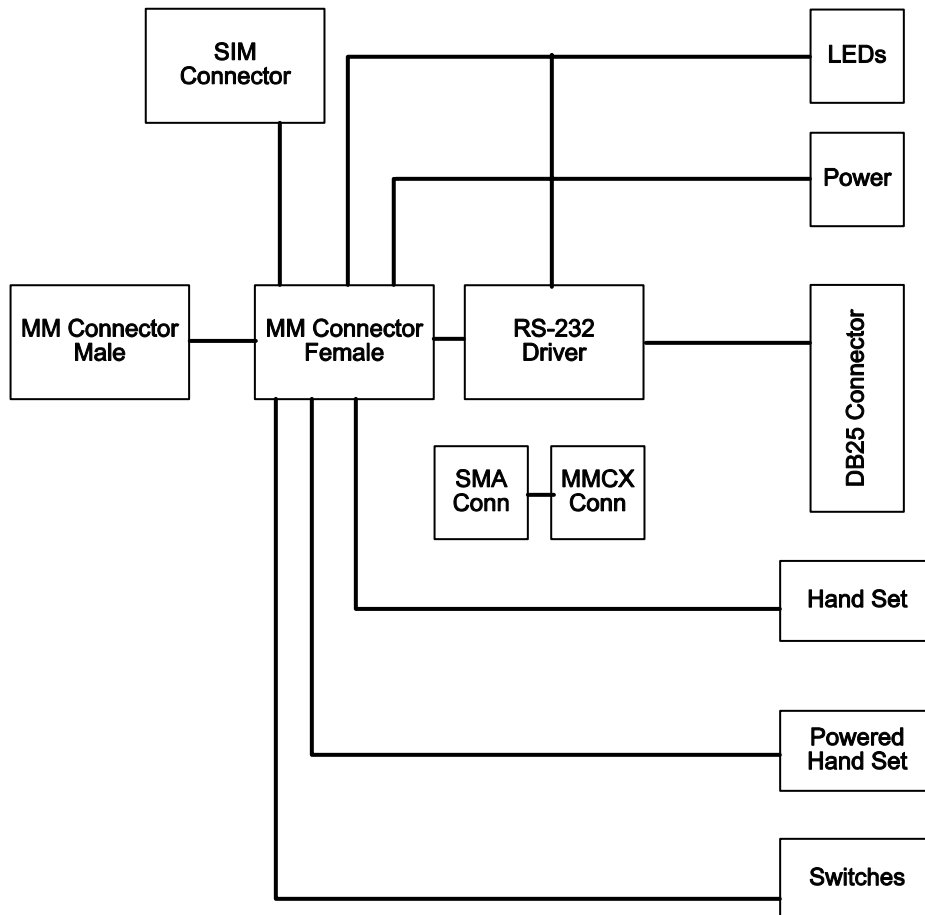


Figure 5-2: Block Diagram for the ModemModule GSM/GPRS Developer Board

Chapter 6 – Application Considerations

General Guidelines for the Use of the ModemModule

Hardware and RF

- Ground plane: MultiTech recommends having a common ground plane for analog, digital and RF grounds.
- Length of the SIM interface lines (15 cm maximum)
- Bias of the Microphone inputs must be properly adjusted when using audio connectors (mic + speaker) 1.
- EMC protection on audio input/output (filters against 900 MHz)
- ESD protection on serial link,
- Possible spurious emission radiated by the application to the RF receiver in the receiver band

The Antenna

The antenna sub-system and integration in the application is a major issue. It is a major issue in the choice of the antenna cable (type, length, performances, thermal resistance, etc.)

These elements could affect GSM performances such as sensitivity and emitted power.

The antenna should be isolated as much as possible from the digital circuitry including the interface signals.

MultiTech recommends shielding the terminal. On terminals including the antenna, a poor shielding could dramatically affect the sensitivity of the terminal. Subsequently, the power emitted through the antenna could affect the application.

Firmware Upgrade

The ModemModule firmware is stored in flash memory, and it can easily be upgraded. Contact the factory for details.

Initial Configuration Using Mobile PhoneTools

For Initial configuration of your wireless device, Multi-Tech offers a Windows-based mobile PhoneTools application. To load mobile PhoneTools, click on the mobile PhoneTools icon on the system CD and follow the on-screen prompts.

Getting Started

Minimum Hardware Interface Required To Get Started

At a minimum, it is necessary to connect the following signals to properly operate the ModemModule:

Table 5-1: Minimum Signals to Operate the ModemModule

<i>Pin Number</i>	<i>Name</i>	<i>Description</i>
1	GND	Ground
2	GND	Ground
3	+5V	Power Supply
4	+5V	Power Supply
6	GND	Ground
13	CT106/CTS	Clear to Send
15	ON/OFF	Power On/Off *
21	GND	Ground
24	GND	Ground
25	CT103/TX	Transmit
28	CT104/RX	Receive
30	CT105/RTS	Request to Send

* Connected to +5V for example

The serial link signals must be used through the implementation of the serial link level shifter. See “Figure 3-3: Level Shifter Application Diagram for Serial Link.”

Terminal Emulator Setup

Here below is an example based on the Windows [™]HyperTerminal application (terminal emulator program).

Setup:

1. Go to START – PROGRAMS – ACCESSORIES – HyperTerminal.
2. Start the HyperTerminal software.
3. Give the name of your choice, click on the icon of your choice, and click “OK.”
4. Choose these operating parameter values:
Connect using: direct to COM1
Properties: 115200 bps; 8 bits data; no parity; 1 stop bit; hardware flow control.
5. Click “OK.”

Once HyperTerminal is open and configured, it can be used to send AT commands to the ModemModule.

For assistance in testing your ModemModule, see the examples in the AT Command manual for MultiTech's GSM/GPRS wireless modem products (*GSM/GPRS AT Commands Reference Guide*).

Reference Documents

Table 5-2: GSM ETSI Recommendations for Phase I and Phase II

Specification Reference	Title
GSM ph2 Radio	ETSI GSM 05.05 and GT 01 v4.2.1
DCS ph2 Radio	ETSI GSM05.05 and GT01 v4.2.1
GSM ph2 Link-Management	ETSI GSM 03.06, 04.08, 05.05, 05.08, 05.10, 07.01 an GT 01 v4.2.1
GSM ph2 Link-Management	ETSI GSM 03.06, 04.08, 05.05, 05.08, 05.10, 07.01 an GT 01 v4.2.1
GSM ph2 Layer 2	ETSI GSM 04.06 and GT 01 v4.2.1
GSM ph2 Layer 3	ETSI GSM 04.08 and GT 01 v4.2.1
DCS ph2 Layer 3	ETSI GSM 04.08 and GT 01 v4.2.1
GSM/DCS Multiband	ETSI GSM 02.07, 03.22, 04.08, 04.13, 05.05, 05.08 an GT 01 v4.2.1
GSM ph2 SIM	ETSI GSM 11.11 and GT 01 v4.2.1
GSM ph2 Teleservices	ETSI GSM 03.50 and GT 01 v4.2.1
GSM ph2 Miscellaneous	ETSI GSM 02.07, 03.40, 03.41, 04.08, 04.10, 04.11, 06.10, 06.11, 06.12, 06.31, 06.32, 07.01, 09.07 and G 01 v4.2.1
DCS ph2 Miscellaneous	ETSI GSM 02.07, 03.40, 03.41, 04.08, 04.10, 04.11, 06.10, 06.11, 06.12, 06.31, 06.32, 07.01, 09.07 and G 01 v4.2.1

You can find the documents on
 ETSI Contacts: ETSI Secretariat
 F-06921 Sophia Antipolis cedex, France 06921 Sophia Antipolis cedex, France 06921 Sophia Antipolis cedex,
 France 06921 Sophia Antipolis cedex, France
 e-mail: secretariat@etsi.fr
<http://www.etsi.org>

Related Manuals

For information on Multi-Tech modem installation, AT commands, S-Registers, and testing; refer to the applicable user manual that came with your Multi-Tech modem. Multi-Tech manuals and other resources are on the Multi-Tech web page at <http://www.multitech.com>.

For additional Multi-Tech information, contact:
<http://www.multitech.com> for News, Products, Solutions, Support, Documents and more.
<ftp://ftp.multitech.com/> for Modem Firmware, Modem INFs, Manuals, Utilities, etc.
 email omsales@multitech.com for email technical support.

Additional Information

European Telecommunications Standards Institute (ETSI) - Contact the ETSI at:
650, route des Lucioles
06921 Sophia-Antipolis Cedex
France
Tel: +33 (0)4 92 94 42 00
Fax: +33 (0)4 93 65 47 16

Global Engineering Documents manages a collection of more than one million documents from over 460 organizations worldwide:
<http://global.ihs.com>
Phone: 800-854-7179
Fax: 303-792-2192

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<http://www.itu.int/publications/>.

Appendix A – Safety

Safety Precautions

IMPORTANT!

FOR THE EFFICIENT AND SAFE OPERATION
OF YOUR GSM/GPRS INTEGRATED MODEM
READ THIS INFORMATION BEFORE USE.

RF Safety

General

Your ModemModule is based on the GSM/GPRS standard for cellular technology. The GSM/GPRS standard is spread all over the world. It covers Europe, Asia and some parts of America and Africa. This is the most used telecommunication standard. Your modem is actually a low power radio transmitter and receiver. It sends out and receives radio frequency energy. When using the ModemModule integrated modem, the cellular system handling the call controls both the radio frequency and the power level of the cellular modem.

Exposure to RF Energy

There has been some public concern about possible health effects of using GSM/GPRS modems. Although research on health effects from RF energy has focused on the current RF technology for many years, scientists have begun research regarding newer radio technologies, such as GSM/GPRS. After existing research had been reviewed, and after compliance to all applicable safety standards had been tested, it has been concluded that the product was fitted for use. If you are concerned about exposure to RF energy there are things you can do to minimize exposure. Obviously, limiting the duration of your calls will reduce your exposure to RF energy. In addition, you can reduce RF exposure by operating your cellular modem efficiently by following the below guidelines.

Efficient Modem Operation

For your modem to operate at the lowest power level, consistent with satisfactory call quality:

- If your modem has an extendible antenna, extend it fully. Some models allow you to place a call with the antenna retracted. However your modem operates more efficiently with the antenna fully extended.
- Do not hold the antenna when the modem is « IN USE ». Holding the antenna affects call quality and may cause the modem to operate at a higher power level than needed.

Antenna Care and Replacement

Do not use the modem with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Replace a damaged antenna immediately. Consult your manual to see if you may change the antenna yourself. If so, use only a manufacturer-approved antenna. Otherwise, have your antenna repaired by a qualified technician. Use only the supplied or approved antenna. Unauthorized antennas, modifications or attachments could damage the modem and may contravene local RF emission regulations or invalidate type approval.

General Safety

Driving

Check the laws and the regulations regarding the use of cellular devices in the area where you have to drive as you always have to comply with them. When using your modem while driving, please: give full attention to driving, pull off the road and park before making or answering a call if driving conditions so require.

Electronic Devices

Most electronic equipment, for example in hospitals and motor vehicles is shielded from RF energy. However RF energy may affect some improperly shielded electronic equipment.

Vehicle Electronic Equipment

Check your vehicle manufacturer representative to determine if any on-board electronic equipment is adequately shielded from RF energy.

Medical Electronic Equipment

Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc...) to determine if they are adequately shielded from external RF energy. Turn your modem OFF in health care facilities when any regulations posted in the area instruct you to do so. Hospitals or health care facilities may be using RF monitoring equipment.

Aircraft

Turn your modem OFF before boarding any aircraft.

- Use it on the ground only with crew permission.
- Do not use it in the air.

To prevent possible interference with aircraft systems, Federal Aviation Administration (FAA) regulations require you to have permission from a crewmember to use your modem while the aircraft is on the ground. To prevent interference with cellular systems, local RF regulations prohibit using your modem while airborne.

Children

Do not allow children to play with your modem. It is not a toy. Children could hurt themselves or others (by poking themselves or others in the eye with the antenna, for example). Children could damage the modem, or make calls that increase your modem bills.

Blasting Areas

To avoid interfering with blasting operations, turn the unit OFF when in a « blasting area » or in areas posted: « turn off two-way radio ». Construction crews often use remote control RF devices to set off explosives.

Potentially Explosive Atmospheres

Turn your modem OFF when in any area with a potentially explosive atmosphere. It is rare, but your modem or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injuries or even death. Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fueling areas such as petrol stations; below decks on boats; fuel or chemical transfer or storage facilities; and areas where the air contains chemicals or particles, such as grain, dust, or metal powders. Do not transport or store flammable gas, liquid, or explosives, in the compartment of your vehicle that contains your modem or accessories. Before using your modem in a vehicle powered by liquefied petroleum gas (such as propane or butane) ensure that the vehicle complies with the relevant fire and safety regulations of the country in which the vehicle is to be used.

Safety Standards

THIS WIRELESS MODEM MODULE COMPLIES WITH ALL APPLICABLE RF SAFETY STANDARDS. This cellular modem meets the standards and recommendations for the protection of public exposure to RF electromagnetic energy established by governmental bodies and other qualified organizations, such as the following:

- Directives of the European Community,
- Directorate General V in Matters of Radio Frequency Electromagnetic Energy

RF Exposures

Pursuant to 47 CFR § 24.52 of the FCC Rules and Regulations, personal communications services (PCS) equipment is subject to the radio frequency radiation exposure requirements specified in § 1.1307(b), § 2.1091 and § 2.1093 as appropriate.

The MultiTech ModemModule is a GSM (Cellular 850/ PCS 1900) terminal which operates in the US licensed PCS frequency spectrum. The device transmits over either the 1850-1910 MHz band or the 824 – 849 MHz band and receives over either the 1930-1990 MHz band or the 869 – 894 MHz band. Multi-Tech Systems, Inc. certifies that it has determined that the Modem complies with the RF hazard requirements applicable to broadband PCS equipment operating under the authority of 47 CFR Part 24, Subpart E of the FCC Rules and Regulations. This determination is dependent upon installation, operation and use of the equipment in accordance with all instructions provided.

The Modem is designed for and intends to be used in fixed and mobile applications. "Fixed" means that the device is physically secured at one location and is not able to be easily moved to another location. "Mobile" means that the device is designed to be used in other than fixed locations and generally in such a way that a separation distance of at least 20cm is normally maintained between the transmitter's antenna and the body of the user or nearby persons. The Modem is not designed for, or intended to be used in portable applications (within 20 cm of the body of the user) and such uses are strictly prohibited. To comply with current FCC regulations limiting both maximum RF output power and human exposure to radio frequency radiation, at least 20cm must be maintained between the unit's antenna and the body of the user and any nearby persons at all times, in all applications and uses. Additionally, in mobile applications, maximum antenna gain must not exceed 3 dBi (to comply with Section 24.232(b) and is limited to 7 dBi for fixed applications. Finally, the tune-up procedure for the modem ensures that the maximum RF output power of the device does not exceed 30.0 dBm within the variations that can be expected due to quantity production and testing on a statistical basis.

Instructions to OEMs

The MultiTech product manual includes specific warnings and cautions in order to ensure that OEMs are aware of their responsibilities, with regards to RF exposure compliance, for products into which the modem is integrated. With this guidance, the OEM will be able to incorporate into their documentation the necessary operating conditions and warnings.

OEMs need to provide a manual with the "final" product that clearly states the operating requirements and conditions and that these must be observed to ensure compliance with current FCC RF exposure requirements / MPE limits (see the "RF Exposures" section above). This will enable the OEM to generate (and provide the end-user with) the appropriate operating instructions, warnings and cautions, and/or markings for their product.

Appendix B – Sourcing Connectors & Peripheral Devices

Where to Find SMD Connectors

The ModemModule matting interface connector is made by SAMTEC France (<http://www.samtec.com/>). Many SAMTEC products are available via SAMTEC dealers throughout the world.



Figure B-1: High and Low Profile Connectors

SAMTEC Reference Number for High-Profile Connector: FLE-125-01-G-DV	SAMTEC Reference Number for Low-Profile Connector: CLP-125-02-L-D
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Figure B-2: Flexible Flat Cable

Reference Number for Flexible Flat Cable: FFSD-25-D-xx.xx-01-N

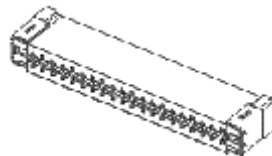


Figure B-3: Flexible Cable Receptacle

SAMTEC Reference Number for Flex Cable Connector: FTS-125-01-L-DV-A

Antenna Cable

An optional 6" antenna can be ordered from Multi-Tech Systems, Inc.

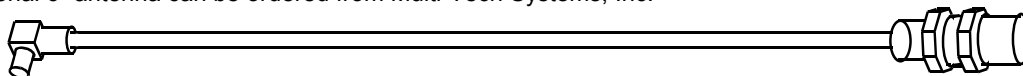


Figure B-4: 6-Inch Antenna Cable – SMA Jack to MMCX Plug

Antenna Cable – SMA Jack to MMCX Plug
Multi-Tech Systems, Inc.
<http://www.multitech.com>
Order No: 45009630

GSM/GPRS Antenna

The integrated modem antenna connector is an MMCX connector. The MMCX connector incorporates a 'Snap On' latching action in order to make the connection easier. It has excellent RF performance. An additional advantage is its small physical size--50% of the standard MCX connector.

This type of connector is suitable for the standard ranges of flexible and semi-rigid cables. The characteristic impedance of the MMCX coaxial connector is 50 ohm. The antenna manufacturer must guarantee that the antenna will be working according to the radio characteristics presented in the table below.

Radio Characteristics

	GSM 850	EGSM 900	DCS 1800	PCS 1900
Frequency RX	869 to 894 MHz	925 to 960 MHz	1805 to 1880 MHz	1930 to 1990 MHz
Frequency TX	824 to 849 MHz	880 to 915 MHz	1710 to 1785 MHz	1850 to 1910 MHz
RF Power Stand	2W at 12.5% duty cycle	2W at 12.5% duty cycle	1W at 12.5% duty cycle	1W at 12.5% duty cycle
Impedance	50 ohms			
VSWR	<2			
Typical Radiated Gain	0 dBi on azimuth plane			

The ModemModule requires an MMCX plug to connect to an antenna.



Figure B-5: MMCX Connector Example (right angle type)

Ordering

An antenna with mating connector can be ordered, for example, from :

IMS Connectors Systems GMBH
<http://www.imscs.com/>

A small MMCX / SMA adapter can be ordered, for example, from :

Amphenol
<http://www.amphenol.com/>
 Order No: 908-31100

SIM Card Holder

The SIM cardholder used in the integrated modem is a MOLEX connector.

Part number connector: 99228.

Part number holder : 91236.

For more information about this connector:

<http://www.molex.com/>

It is possible to use a stand-alone SIM cardholder through the 50-pin connector but the length of the SIM line must not exceed 15 cm.

Appendix C – Warranty and Service

Multi-Tech Warranty Statement

Multi-Tech Systems, Inc., (hereafter “MTS”) warrants that its products will be free from defects in material or workmanship for a period of two, five, or ten years (depending on model) from date of purchase, or if proof of purchase is not provided, two, five, or ten years (depending on model) from date of shipment.

MTS MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

This warranty does not apply to any products which have been damaged by lightning storms, water, or power surges or which have been neglected, altered, abused, used for a purpose other than the one for which they were manufactured, repaired by Customer or any party without MTS's written authorization, or used in any manner inconsistent with MTS's instructions.

MTS's entire obligation under this warranty shall be limited (at MTS's option) to repair or replacement of any products which prove to be defective within the warranty period or, at MTS's option, issuance of a refund of the purchase price. Defective products must be returned by Customer to MTS's factory — transportation prepaid.

MTS WILL NOT BE LIABLE FOR CONSEQUENTIAL DAMAGES, AND UNDER NO CIRCUMSTANCES WILL ITS LIABILITY EXCEED THE PRICE FOR DEFECTIVE PRODUCTS.

Repair Procedures for U.S. and Canadian Customers

In the event that service is required, products may be shipped, freight prepaid, to our Mounds View, Minnesota factory:

Multi-Tech Systems, Inc.
2205 Woodale Drive
Mounds View, MN 55112
Attn: Repairs, Serial # _____

A Returned Materials Authorization (RMA) is not required. Return shipping charges (surface) will be paid by MTS to destinations in U.S. and Canada.

Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), your telephone number, and if the product is out of warranty, a check or purchase order for repair charges.

For out of warranty repair charges, go to www.multitech.com/DOCUMENTS/Company/warranty/

Extended two-year overnight replacement service agreements are available for selected products. Please call MTS customer service at (888) 288-5470 or visit our web site at www.multitech.com/PARTNERS/Programs/orc/ for details on rates and coverage's.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department at (800) 972-2439 or email support@multitech.com. Please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at (800) 328-9717 or (763) 717-5631, or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Customers (Outside U.S.A. and Canada)

Your original point of purchase Reseller may offer the quickest and most economical repair option for your Multi-Tech product. You may also contact any Multi-Tech sales office for information about the nearest distributor or other repair service for your Multi-Tech product. The Multi-Tech sales office directory is available at

www.multitech.com/PARTNERS/Channels/offices/

In the event that factory service is required, products may be shipped, freight prepaid to our Mounds View, Minnesota factory. Recommended international shipment methods are via Federal Express, UPS or DHL courier services, or by airmail parcel post; shipments made by any other method will be refused. A Returned Materials Authorization (RMA) is required for products shipped from outside the U.S.A. and Canada. Please contact us for return authorization and shipping instructions on any International shipments to the U.S.A. Please include, inside the shipping box, a description of the problem, a return shipping address (must have street address, not P.O. Box), your telephone number, and if the product is out of warranty, a check drawn on a U.S. bank or your company's purchase order for repair charges. Repaired units shall be shipped freight collect, unless other arrangements are made in advance.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our Technical Support department nearest you or email support@multitech.com. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at +(763) 717-5631 in the U.S.A., or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Repair Procedures for International Distributors

International distributors should contact their MTS International sales representative for information about the repairs for their Multi-Tech product.

Please direct your questions regarding technical matters, product configuration, verification that the product is defective, etc., to our International Technical Support department at +(763)717-5863. When calling the U.S., please direct your questions regarding repair expediting, receiving, shipping, billing, etc., to our Repair Accounting department at +(763) 717-5631 in the U.S.A. or email mtsrepair@multitech.com.

Repairs for damages caused by lightning storms, water, power surges, incorrect installation, physical abuse, or user-caused damages are billed on a time-plus-materials basis.

Replacement Parts

SupplyNet, Inc., can supply you with replacement power supplies, cables and connectors for selected Multi-Tech products. You can place an order with SupplyNet via mail, phone, fax or the Internet at the following addresses:

Mail: SupplyNet, Inc.
614 Corporate Way
Valley Cottage, NY 10989
Phone: 800 826-0279
Fax: 914 267-2420
Email: info@thesupplynet.com
Internet: <http://www.thesupplynet.com>

Appendix D – Acronyms and Abbreviations

ADC :	Analog Digital Converter
ASIC :	Application Specific Integrated Circuit
BCCH :	Broadcast Control Channel
CE :	Communauté Européenne
CLK :	Clock
CTS :	Clear To send
dB :	Decibel
DCD :	Data Carrier Detect
DCE :	Data Circuit Terminating Equipment
DSR :	Data Set Ready
DTE :	Data Terminal Equipment
DTR :	Data Terminated Ready
EFR :	Enhanced Full Rate
E-GSM :	Extended- GSM
EMC :	Electromagnetic Conformity
EN :	Enable
ETSI :	European Telecommunications Standards Institute
FAC :	Final Assembly Code
FR :	Full-Rate
FTA :	Full Type Approval
GND :	Ground
GPIO :	General Purpose Input Output
GPRS :	General Packet Radio Service
GSM :	Global System for Mobile Communication
HR :	Half-Rate
IMEI :	International Mobile Equipment Identity
MO :	Mobile Originated
MT :	Mobile Terminated
OEM :	Original Equipment Manufacturer
PDA :	Personal Digital Assistant
PCB :	Printed Circuit Board
PRES :	Presence
RI :	Ring Indicator
RTS :	Request To Send
SIM :	Subscriber Identity Module
SMD :	Surface Mounted Design
SMS :	Short Message Service
TAC :	Type Approval Code
TDMA :	Time Code Multiple Access
TE :	Terminal Equipment
VSWR :	Voltage Standing Wave Ratio
WAP :	Wireless Application Protocol

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